Classification of soft-tissue injuries in open femur fractures: Relevant for systemic complications?

Weber, Christian David ; Lefering, Rolf ; Dienstknecht, Thomas ; Kobbe, Philipp ; Sellei, Richard Martin ; Hildebrand, Frank ; Pape, Hans-Christoph ; TraumaRegister DGU

Abstract: BACKGROUND A broad range of systemic complications has been described to occur in patients with open major fractures. Various causes have been claimed to play a role. We therefore surveyed a nationwide trauma registry to assess risk factors associated with closed and various types of open femur fractures. METHODS This was a cohort study in a nationwide population-based prospective database. Inclusion criteria for selection from database are as follows: individuals with femur fracture, age 16 years or older, and survival until primary admission. Main groups included closed and open femur fracture. Patient demographics, injury severity (New Injury Severity Score), surgical fracture management, length of stay, and systemic complications (e.g., multiple organ failure [MOF], sepsis, mortality) were collected and statistically analyzed using SPSS statistics. Multivariate regression analysis was performed to stratify subgroups for the degree of open soft-tissue injury according to Gustilo and Anderson. RESULTS Among 32,582 documented trauma victims (January 1, 2002, to December 31, 2010), a total of 5,761 met the inclusion criteria. Main groups: 4,423 closed (76.8%) and 1,338 open femur fractures (23.2%). Open fractures subgroups were divided into I° (334, 28.1%), II° (526, 44.3%), and III° (328, 27.6%). Open fractures were associated with an increased risk of prehospital hemorrhagic shock ($p = 0.01$), higher resuscitation requirements ($p < 0.001$), MOF ($p = 0.001$), and longer in-hospital ($p < 0.001$) and intensive care stay ($p = 0.001$). While New Injury Severity Score values showed a minor increase per subgroup, the prevalence of MOF, sepsis, and mortality multiplied with the degree of open soft-tissue injury. Especially patients with Type III open femur fractures received mass transfusions (28.2%, $p < 0.001$), and mass transfusions were identified as independent predictor for sepsis (odds ratio [OR], 2.393; 95% confidence interval [CI], 1.821-3.143; $p < 0.001$) and MOF (OR, 2.966; 95% CI, 2.409-3.651; $p < 0.001$). Our data also indicate an increased mortality in patients with open femur managed outside Level I trauma centers (OR, 1.358; 95% CI, 1.018-1.812; $p = 0.037$). CONCLUSION Open femur fractures are associated with higher in-hospital complications related to incidence of MOF, associated intensive care unit stay, and hospital days when compared with closed femur fractures. For prevention of in-hospital complications, prompt hemorrhage control, surgical fracture fixation, cautious blood management, and triage to a Level I trauma center must be considered. LEVEL OF EVIDENCE Epidemiologic/prognostic study, level II.

DOI: https://doi.org/10.1097/TA.0000000000001216

Originally published at:
Weber, Christian David; Lefering, Rolf; Dienstknecht, Thomas; Kobbe, Philipp; Sellei, Richard Martin; Hildebrand, Frank; Pape, Hans-Christoph; TraumaRegister DGU (2016). Classification of soft-tissue injuries in open femur fractures: Relevant for systemic complications? Journal of Trauma and Acute Care Surgery, 81(5):824-833.
DOI: https://doi.org/10.1097/TA.0000000000001216

Classification of soft-tissue injuries in open femur fractures: Relevant for systemic complications?

Weber, Christian David MD; Lefering, Rolf PhD; Dienstknecht, Thomas MD, PhD; Kobbe, Philipp MD, PhD; Sellei, Richard Martin MD; Hildebrand, Frank MD, PhD; Pape, Hans-Christoph MDTraumaRegister DGU

Journal of Trauma and Acute Care Surgery: November 2016 - Volume 81 - Issue 5 - p 824–833
doi: 10.1097/TA.0000000000001216
AAST Plenary Papers

Abstract **Author Information**

BACKGROUND A broad range of systemic complications has been described to occur in patients with open major fractures. Various causes have been claimed to play a role. We therefore surveyed a nationwide trauma registry to assess risk factors associated with closed and various types of open femur fractures.

METHODS This was a cohort study in a nationwide population-based prospective database. Inclusion criteria for selection from database are as follows: individuals with femur fracture, age 16 years or older, and survival until primary admission. Main groups included closed and open femur fracture. Patient demographics, injury severity (New Injury Severity Score), surgical fracture management, length of stay, and systemic complications (e.g., multiple organ failure [MOF], sepsis, mortality) were collected and statistically analyzed using SPSS statistics. Multivariate regression analysis was performed to stratify subgroups for the degree of open soft-tissue injury according to Gustilo and Anderson.

RESULTS Among 32,582 documented trauma victims (January 1, 2002, to December 31, 2010), a total of 5,761 met the inclusion criteria. Main groups: 4,423 closed (76.8%) and 1,338 open femur fractures (23.2%). Open fractures subgroups were divided into I° (334, 28.1%), II° (526, 44.3%), and III° (328, 27.6%). Open fractures were associated with an increased risk of prehospital hemorrhagic shock ($p = 0.01$), higher resuscitation requirements ($p < 0.001$), MOF ($p = 0.001$), and longer in-hospital ($p < 0.001$) and intensive care stay ($p = 0.001$). While New Injury Severity Score values showed a minor increase per subgroup, the prevalence of MOF, sepsis, and mortality multiplied with the degree of open soft-tissue injury. Especially patients with Type III open femur fractures received mass transfusions (28.2%, $p < 0.001$), and mass transfusions were identified as independent predictor for sepsis (odds ratio [OR], 2.393; 95% confidence interval [CI], 1.821–3.143; $p < 0.001$) and MOF (OR, 2.966; 95% CI, 2.409–3.651; $p < 0.001$). Our data also indicate an increased mortality in patients with open femur managed outside Level I trauma centers (OR, 1.358; 95% CI, 1.018–1.812; $p = 0.037$).

CONCLUSION Open femur fractures are associated with higher in-hospital complications related to incidence of MOF, associated intensive care unit stay, and hospital days when compared with closed femur fractures. For prevention of in-hospital complications, prompt hemorrhage control, surgical fracture fixation, cautious blood management, and triage to a Level I trauma center must be considered.

LEVEL OF EVIDENCE Epidemiologic/prognostic study, level II.

From the Department of Orthopaedics and Trauma, RWTH Aachen University, Aachen, Germany (C.D.W., T.D., P.K., R.M.S., F.H., H.-C.P.); Harald Tscherne Laboratory for Orthopaedic Research, Aachen, Germany (C.D.W.); Institute for Research in Operative Medicine (IFOM), Witten/Herdecke University, Cologne, Germany (R.L.); and Committee on Emergency Medicine, Intensive Care and Trauma Management (Sektion NIS) of the German

Trauma Society (DGU), Germany (T.R.).

Submitted: July 29, 2015, Revised: May 29, 2016, Accepted: June 10, 2016, Published online: August 16, 2016.

The Trauma Registry of the German Trauma Society (Deutsche Gesellschaft fur Unfallchirurgie) was partly funded by the Deutsche Forschungsgemeinschaft Ne 385/5 and by a grant from Novo Nordisk A/S, Bagsvaerd, Denmark.

The paper was presented at the 74th annual meeting of the American Association for the Surgery of Trauma, September 9 to 12, 2015, in Las Vegas, Nevada.

Address for reprints: Christian David Weber, MD, Department of Orthopaedics and Trauma, RWTH, Aachen University Hospital, Pauwels St. 30, 52074 Aachen, Germany; email: chrweber@ukaachen.de.